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UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
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H. H. BENNETT, CHIEF

ADVANCE REPORT

on the

SEDIMENTATION SURVEY OF LAKE PURDY

BIRMINGHAM, ALABAMA

November 6 - November 23, 1935

by

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Division of Research
Section of Hydrodynamic Studies
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GENERAL INFORMATION

Location: State: Alabama.

Counties: Jefferson and Shelby. The dam is in SW$\frac{1}{4}$, Sec. 17, T. 18 S., R. 1 W.

Distance and direction from nearest city: The dam is 8.8 miles airline, 12 miles by road, southeast of Birmingham.

Drainage and backwater: The Little Cahaba River, flowing southwest. The principal tributary on which water is impounded is Cox Creek, which enters the lake from the south.

Ownership: Birmingham Waterworks Company.

Purpose served: Auxiliary storage for water supply of Birmingham.

Description of dam: The dam is a gravity-type concrete structure with a facing of limestone blocks. It is 60 feet high, 8.5 feet thick at the top, 61 feet thick at the base, and 408 feet long. The upstream face of the dam is vertical.

The spillway extends across the top of the dam with a net crest length of 213 feet. The gate house divides the spillway into two segments with lengths of 146 feet and 67 feet on the north and south sides, respectively. The spillway crest elevation is 550.37 feet above mean sea level, U. S. G. S. datum.

A 20-inch valve is located 20 feet above the base of the dam, and a 30-inch valve is located at the bottom. The intake is 500 feet upstream from the dam.

The limestone facing of the dam was quarried from a nearby outcrop in the basin of the lake. The blocks are arranged steplike on the spillway, and the water passing over them, especially in flood time, presents a spectacular display.

The dam is constructed in the narrows or watergap where the Little Cahaba River cuts through Newhope Mountain (Mill Ridge north of the gap). This is a long ridge, 250 to 300 feet higher than the valley to the east, formed by the outcrop of the Copper Ridge formation, a cherty dolomite of Ordovician age that is highly resistant to erosion. Three miles southwest of the gap the Little Cahaba River joins the Cahaba, a southward flowing stream which in turn joins the Alabama River at Selma in the south-central part of the state.

Date of completion: The dam was completed to a height of 40 feet in September 1910, and raised to 60 feet in June 1929. The original date of completion and the present crest level were used in the computations of this survey. The age of the reservoir at the date of survey, November 1935, was 25.2 years.

Length of lake (original and present as scaled from base map): 3.88 miles up the Little Cahaba River, and 1.63 miles up Cox Creek from the original junction of the creek with the river.

Area of lake at crest stage (original and present as planimetered from the original map): 972.38 acres.

Storage capacity at crest stage (determined by this survey):

	Acre-feet	Gallons
Original	19,080	6,217,218,000
Present	18,594	6,058,855,000
Loss due to silting	486	158,363,000

General character of reservoir basin: The basin of Lake Purdy occupies a portion of a broad valley containing small ridges. The lake is irregular in outline due to the somewhat meandering course of the Little Cahaba and to the large number of tributary streams on which water is impounded. A portion of a ridge through which the Little Cahaba River and Cox Creek had cut their channels now appears as an elongated island. The southwest continuation of the ridge forms a prominent peninsula between two arms of the lake. The headwater portion of the Cox Creek arm lies behind another ridge in a chicken-foot pattern. The approximate average width of the lake is 1150 feet. The original channel of the Little Cahaba has an average slope of 15.46 feet per mile through the basin.

The surface of the original basin consisted of residual clay, boulders and exposures of bedrock, and a narrow strip of valley alluvium. Some of the boulders still project through the thin blanket of sediment covering the reservoir basin. The floor of the original channel was of chert sand in places, and of bare rock elsewhere.

Area of watershed: 41.74 square miles, planimetered from U.S.G.S. topographic maps. 1/

General character of watershed: The watershed of the Little Cahaba River lies in north-central Alabama in the Cahaba Valley, a part of the Cahaba Ridges section of the Appalachian Valley Province. The valley is bordered by steep-sloped narrow ridges and contains several minor ridges.

Form of the valley: The watershed of Lake Purdy is a uniquely rectangular area, elongated in a northeast direction 17 miles long and averaging 2½ miles wide. It extends from a point 4½ miles south of Lake Purdy dam to Moody, 4 miles northeast of Leeds. The valley lies between Oak Mountain on the southeast and Newhope Mountain and Pine Ridge on the northwest. The outlet of the watershed is the watergap cut by the Little Cahaba River.

Topography: The watershed is sharply delimited on the southeastern and northwestern sides by narrow ridges. The northeastern and southwestern ends are ill-defined in the gently rolling valley surface which continues beyond this watershed.

The following table shows the principal topographic features of the watershed, their elevations, and the character of the material forming them:

1/ U.S.G.S. Topographic Sheets, Vandiver Quadrangle, scale 1/62,500, contour interval 50 feet, surveyed in 1906; Leeds Quadrangle, scale 1/62,500, contour interval 20 feet, surveyed in 1904-1905; Springville Quadrangle, scale 1/125,000, contour interval 100 feet, surveyed in 1887.

TABLE 1.

Topographic feature	Average elevation above sea level, in feet	Character of rock
1. Summit of Oak Mountain, the southeastern boundary of the watershed	1150	Sandstone (Pottsville, Carboniferous age)
2. Northwestern slope of Oak Mountain	650-1100	Shale and sandstone (Parkwood, Carboniferous age)
3. Valley bottom ½ mile west of Oak Mountain	600-650	Shale (Floyd, Carboniferous age)
4. Little Oak Ridge	750	Chert (Fort Payne, Carboniferous age)
5. Valley proper, averaging 1 mile wide and containing at least 2 minor ridges 50-100 feet in height	550-650	Valley of Ordovician limestone; ridges of cherty dolomite (Chepultepec, Cambrian or Ordovician age)
6. Newhope Mountain (Pine Ridge, north of dam), forming the western boundary of the watershed. Purdy Dam is located in a gap in this ridge.	750-900	Cherty dolomite (Copper Ridge, Cambrian or Ordovician age)

Geology: The watershed of the Little Cahaba is underlain in about two-thirds of its area by limestone and dolomitic rocks, and in the other third by shale and sandstone. It lies on the western limb of a syncline 2/ and the rocks dip at a steep angle southeastward throughout the area. The upturned edges of resistant formations are exposed or only thinly covered by soil at many places, so that the value of the area for cultivation is limited.

2/ Adams, George I., Butts, Charles, Stephenson, L. W., and Cooke, C. Wythe, Geology of Alabama: Geological Survey of Alabama Special Report No. 14 and accompanying geologic map, 1926.

The minor ridges within the valley and the ridge forming the western boundary of the watershed are composed, in general, of cherty dolomite, whereas the valley floor is made up of weak shales and pure limestones. The sharp ridge on the eastern edge of the watershed is composed of sandstone overlying shales.

Soils: The following table lists the principal soils types, their origin, and characteristics:

TABLE 2.

Soil type and origin	Position	Topsoil Color	Subsoil Color	Subsoil Structure
Dekalb, from sandstone and shale	ridge tops	gray to yellowish gray	pale yellow	friable
Hanceville, from sandstone and shale	slopes	grayish brown to red	red	friable
Clarksville, from cherty dolomite	ridges	gray to yellowish gray	pale yellow	friable and contains chert fragments
Frederick, from cherty dolomite	ridges	gray to brownish yellow	reddish yellow or salmon grading at 10 to 18 in. into yellowish red or red	rather heavy but friable
Decatur, from pure limestone	valleys	dark red or reddish brown	deep red	rather heavy
Hagerstown, from pure limestone	valleys	brown or yellow	reddish yellow or reddish brown	friable

The percentages of the various types of soil in the watershed, as planimetered from soils maps of the region, 3/ are given below:

- -

3/ 1. Stroud, J. F., Smith, N. C., and Agee, J. H., Soil survey of Shelby County, Alabama: U. S. Dept. of Agriculture, Bureau of Chemistry and Soils, 1920 (Advance Sheets - Field operations of the Bureau of Soils, 1917).

2. Burke, R. T. A., and Bell, N. E., Soil survey of St. Claire County, Alabama: U. S. Dept. of Agriculture, Bureau of Chemistry and Soils, 1920 (Advance Sheets - Field operations of the Bureau of Soils, 1917).

3. Smith, Howard C., and Pace, E. S., Soil survey of Jefferson County, Alabama: U. S. Dept. of Agriculture, Bureau of Chemistry and Soils, Field operations of the Bureau of Soils pp. 737-769 1908, published 1911.

Soil Type	Percent
Abernathy silty clay loam	.10
Clarksville gravelly loam	4.59
Clarksville stony loam	25.69
Clarksville silt loam	0.17
Conasauga clay	0.67
Colbert silty clay loam	2.50
Decatur loam	3.64
Decatur clay loam	3.72
Dekalb stony loam	0.89
Dekalb silt loam	1.36
Dekalb fine sandy loam	0.40
Frederick stony loam	0.32
Frederick gravelly loam	1.39
Hagerstown loam	16.22
Hagerstown stony loam	2.58
Hagerstown gravelly loam	1.76
Hanceville gravelly loam	4.41
Huntington gravelly loam	1.44
Huntington silt loam	0.94
Montevallo shale loam	1.17
Pope silt loam	1.39
Rough broken land	5.38
Rough stony land	12.30

The Rough stony and Rough broken land, comprising about 18 percent of the watershed, consists either of rock exposures or of material classed in the Dekalb, Hanceville, Clarksville, Frederick, Hagerstown, or Montevallo series. Only about 2 percent of this type of land, or 10 to 12 acres per square mile, is cultivated. All virgin timber, and in many places the less valuable second growth, has been removed. Longleaf pine, shortleaf pine, old-field pine, and cedar are now common in dry places. Hickory, beech, poplar, maple, dogwood, persimmon, gum, oaks and haw are less common species. Oak and pine together constitute over one-half of the woodland growth.

From the standpoint of agricultural productivity the Hagerstown is the most valuable soil in the watershed. In places where ledges of rock project through the surface soil or where the soil is shallow it is used for pasture. About 50 percent of this type is cultivated.

The first bottom soils comprise the Pope and Huntington silt loams. The Pope is derived from sandstone and shale soils, the Huntington from limestone soils. Both have brown topsoil and light-brown subsoil and are quite productive where they occur in areas large enough to be cultivated.

Erosion conditions: Slopes on both sides of the valley and on

ridges within the valley, with 10 to 40 percent grade, show severe sheet erosion with occasional gullies where deforested, but only slight erosion where the vegetative cover remains. Sheet erosion is moderate and gullies are few on the valley bottoms, which have slopes of less than 10 percent.

Land Use: Forests: Approximately 70 percent of the watershed is in woodland. Much of the country was originally covered with forests of longleaf pine, intermingled with various oaks, chestnut, walnut, and a small proportion of shortleaf pine. Now the longleaf pine is being gradually replaced by less valuable species of pine and scrub oak.

The sandstone ridge on the eastern boundary of the watershed and the limestone valleys have a smaller percentage of longleaf pine than other parts of the region. Hardwoods prevail in the valleys, and cedar is more common on the limestone outcrops than elsewhere. The principal trees on the dry uplands, in addition to the pines and cedar, are hickory, beech, chinquapin, poplar, maple, dogwood, persimmon, gum, oaks, haw, wild plum, and wild cherry. Oaks and pines constitute more than half of the tree growth. In the valleys and near the streams the most common trees are red maple, poplar, sweetgum, and willows.

Pastures: Approximately 15 percent of the valley bottom is in open pasture, since extensive limestone exposures and thin soil make it unfit for cultivation. The pastures are covered with Johnson grass, crab grass, crowfoot grass, "hurrah" grass, some Bermuda grass, and other grasses and sedges. Some of the woods are pastured, although those on steeper ridges are suitable only for raising goats.

Cultivated land and crops: Only about 15 percent of the watershed is cultivated, agriculture being confined almost entirely to the gently rolling valley. The principal crops are corn, cotton, hay (cowpeas, sorghum, and green-cut grain), oats, wheat, sorghum, peanuts, velvet beans, sweet and irish potatoes, and fruits.

Mean annual rainfall: 49.48 inches at Birmingham, 9 miles west of the lake, and 52.32 inches at Ashville, 21 miles above the head of the watershed.

Inflow: No gaging records are available. In addition to the inflow from the Little Cahaba River and its tributaries, an estimated supply of several million gallons per day is furnished during dry seasons by sub-aqueous springs in the reservoir basin, according to the engineers of the Birmingham Waterworks Company.

Evaporation: The U.S. Weather Bureau station at Silverhill, Baldwin County, Alabama, 20 miles southeast of Mobile, records an average annual evaporation of 36.46 inches for the 6-year period 1918 to 1923.

This station was moved to Fairhope, 9 miles west of Silverhill, in 1934 and is the only station maintained in the state by the U. S. Weather Bureau.

Draft: An average of 25,000,000 gallons per day and a maximum of 35,000,000 gallons per day is used from the lake in dry seasons of the year.

HISTORY OF SURVEY

The sedimentation survey of Lake Purdy was made in the period November 6 to November 28, 1935, by the Eastern Reservoir Party, Section of Hydrodynamic Studies, Division of Research. The personnel of the party consisted of Louis M. Seavy, Party Chief, Gene A. Zwerner, Assistant Chief, Earl H. Moser, Jr., William G. Shannon, George Schn, and Arnold B. Taylor. A study of the sedimentation features of the lake and a brief reconnaissance of the watershed was made by the writer.

During the survey 60 triangulation stations and 38 ranges were established. The triangulation network was expanded from two base lines, beginning at station 1000 and extending 1191 feet and 991 feet, respectively, to stations 1001 and 1002. Two base lines were necessary because of the division of the lake into two bodies by an elongated island. Separate divisions of the triangulation network were expanded from the base lines on either side and united at the ends of the island. The ranges across the narrow portions of the lake, toward the head of backwater and up the arms, were set up and tied together by stadia. The entire basin was surveyed by the range method, since it was possible to penetrate the silt to the old soil contact with the sampling spud. None of the shoreline was remapped, because the original map of the reservoir basin was of sufficient accuracy for the standards of this survey. The accuracy was checked by superimposing the triangulation network, together with portions of shoreline mapped during this survey, on the original map.

A mapping scale of 300 feet to the inch was used in this survey to correspond with that of the original map made about 1905.

ACKNOWLEDGEMENTS

The Soil Conservation Service acknowledges the cooperation of Mr. H. B. Richards, General Manager of the Birmingham Waterworks Company, and Mr. W.H.H. Putnam, assistant to the General Manager, in placing the maps of the lake, various data and information, and a motor for use in the survey at the disposal of the survey party.

Personal assistance of Mr. J. F. Stroud and Mr. J. C. Stephens of the Dadeville office of the Soil Conservation Service in supplying data on the watershed was exceptionally valuable.

DISTRIBUTION, CHARACTER, AND ORIGIN OF SEDIMENT

For purposes of description Lake Purdy may be considered in three sections: the lower basin at the present lake level, the delta at the former level (prior to 1929), and the headwater portion at the present level.

In the lower basin at the present level, below segment XIV of the main body of the lake and segment XXX of the Cox Creek arm, the

maximum depths of silt occur in the old channels of the streams. These depths range from slightly over 1 foot to slightly over 2 feet. In the river channel on range 1-2, 600 feet upstream from the dam, the maximum silt depth is 1.9 feet. Depths outside of the channel decrease from this maximum to zero where the deposits wedge out near the shore.

Old delta deposits, formed before the crest level was raised 20 feet in 1929, were found in segments XIV and XV of the main body of the lake and in segments XXX and XXXII of Cox Creek arm. A maximum thickness of 3.5 feet of silt was found on the ranges bounding these segments. On each range the thickest body of silt was found on one side of, rather than equally distributed across, the original channel. This distribution is probably due to the scouring action of a fairly strong current, developed along the deeper parts of the cross section (normally the old channel) especially during period of drawdown. The submerged old flood-plain in these segments rarely has more than 2 feet of sediment.

The silt deposits are thinner near the head of backwater than on the delta of the original lake. The maximum thicknesses are usually less than 2 feet, although in some places they are greater, due to local conditions. Here again the silt is usually thickest in one side of the channel. Little of the old flood-plain is submerged in the upper part of the lake, but where submerged it usually has a thin covering of silt, which is beginning to level the depressions and obscure tree stumps and boulders of limestone.

Character of sediment: The part of the lake below the old delta is covered with bottomset beds of uniformly fine muddy sediment. This material is light gray in color and shows little evidence of stratification, either in color or in character of material. This is in contrast to the sediment in the submerged delta of the old lake level where a bed of fine-textured silt and clay overlies coarser-textured silt and coarse sand.

In the upper portions of both arms of the lake the sediment in the channel consists of sand and sandy silt, whereas that on the submerged flood plain consists of mud. This mud becomes thoroughly compacted and dried when exposed for several days during periodic drawdowns of the lake and show mud-cracks characteristic of drying fine-grained sediments.

Origin of sediment: A considerable portion of the sediment in Lake Purdy results from the erosion of soils from the steeper slopes. Although these soils in places are thin and rocky, they are subject to severe sheet and gully erosion wherever the forest cover is removed. Some of the coarser material creeps, washes, and slides down the slopes and is deposited at or near the foot of the slope, but most of the finer particles eventually find their way to the lake. The fact that this land is generally unfit for cultivation and forests are allowed to cover it is a factor of great importance in decreasing the rate of sedimentation of the lake downstream.

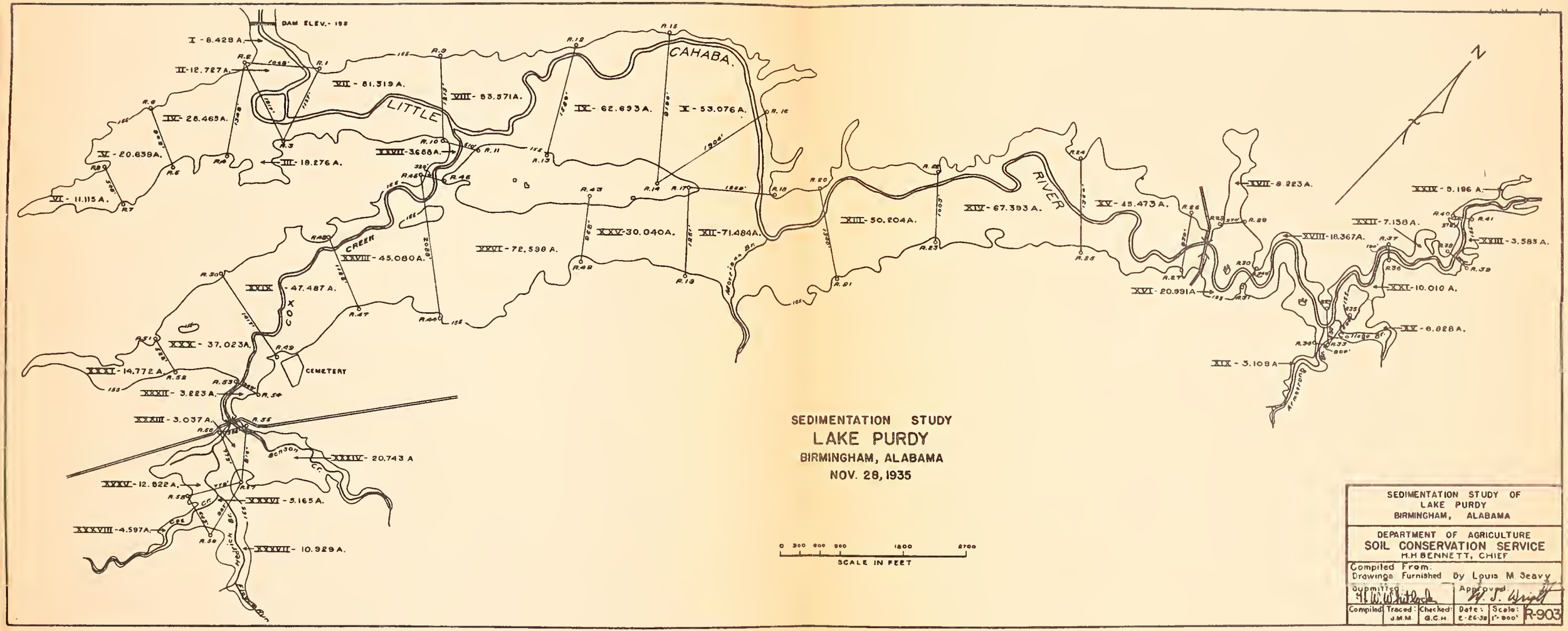
The other principal source of sediment in Lake Purdy is sheet erosion in the broad, gently rolling valley. Most of the agricultural

land of the watershed is in the valley, but, due to the coherent texture of the soil and the particular land-use of the valley, erosion is moderate there. Outcrops of limestone makes a great portion unfit for tillage, a fact which reduces soil loss to a great extent and thus precludes extensive silting of the lake.

Table 3.--Statistical summary of data relating to LAKE PURDY, BIRMINGHAM, ALA.

	Quantity	Unit
Age: 1/	25.2	Years
Watershed:		
Total area	41.74	Sq. Mi.
Reservoir:		
Original area at crest stage	972.38	Acres
Present area at crest stage	972.38	Acres
Original storage capacity	19,080	Acre-fee
Present storage capacity	18,594	Acre-fee
Original storage per square mile of drainage area	457.12	Acre-fee
Present storage per square mile of drainage area	445.47	Acre-fee
Sedimentation:		
Delta deposits .....Not measured separately		
Bottomset beds		
Total sediment	486	Acre-fee
Accumulation per year, average	19.29	Acre-fee
Accumulation per year per 100 square miles drainage area	46.21	Acre-fe
Accumulation per year per acre of drainage area	31.45	Cubic fe
Or, assuming average weight of 1 cubic foot of silt is 100 pounds	1.57	Tons
Depletion of storage:		
Percent loss of original capacity per year	0.10	Percent
Percent loss of original capacity to date of survey	2.55	Percent

1/ Date storage began: September 1910. Date of this survey: November 1935.



SEDIMENTATION STUDY
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NOV. 28, 1935

SEDIMENTATION STUDY OF
LAKE PURDY
BIRMINGHAM, ALABAMA

DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
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